



Section II- User Manual

FFD 3.5" SCSI Flash Disk

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1 General

This manual provides you with the information you need to properly install your new FFD 3.5" SCSI Flash drive. M-Systems recommends that only properly qualified and trained personnel install the drive.

The following sections contain information about handling, mounting considerations, address and configuration setups, cabling and connectors, and how to obtain technical assistance and service. In addition, Section 10 provides answers to common questions regarding SCSI devices.

Note: Remember to always back up your data before adding disk drives to your system!

2 Kit Contents

Ensure that your kit contains the following items:

- FFD 3.5" SCSI Flash Disk. (Throughout the remainder of this document the FFD 3.5" SCSI Flash Disk will be referred to as FFD).
- 4 mounting screws, M-Systems part no. 01-SC-034-00.

If any items are missing, please contact your dealer.

3 Visual Inspection

Before unpacking or handling a drive, take all proper electrostatic discharge (ESD) precautions, including personnel and equipment grounding. Before you begin installing the FFD into your system, verify the following:

- If the shipping container appears to be damaged or water-stained, notify your dealer.
- Remove the disk from its shipping enclosure and inspect it for any damage that may have occurred during shipment. If any damage is observed, notify your dealer.
- Record the disk serial number and shipment date.
- Retain the original shipping enclosure and all packing material for reshipment.

4 Handling Instructions

You can prolong the life of your FFD, increase its reliability and prevent unnecessary damage by following the instructions listed below. Failure to follow any of these instructions may void your warranty.

- Always take all proper ESD precautions, including personnel and equipment grounding.
- Always operate the FFD within the environmental specifications.
- Always use a grounded wrist strap when handling the FFD. Drives that are not installed in the system are sensitive to ESD damage.
- Always handle the FFD carefully.
- Never apply DC power to the drive by plugging an electrically live source cable into the drive's power connector.

5 Installation

5.1 System Requirements

In order to install the FFD in your system, ensure that you have the following items:

- System mounting hardware
- 4-pin power cable
- 50-pin ribbon SCSI cable
- SCSI host adapter
- Appropriate device driver for your operating system and SCSI host adapter

5.2 FFD 3.5" SCSI Drive Configuration

Before mounting the drive in the system drive bay, you must configure the FFD by setting the DIP switches on the front panel to meet your system requirements. Any changes to the DIP switch settings must be done while the FFD is powered OFF, otherwise the FFD may be damaged or the new settings may not be recognized.

Figure 1 shows the orientation of the DIP switches. Note that the numbers are displayed upside down. However, the order of the DIP switches correspond correctly to the numbers printed next to each switch.

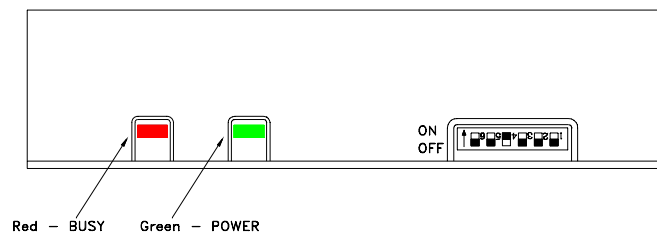


Figure 1: Front Panel DIP Switches

5.2.1 SCSI ID

Every device on the SCSI bus must have a unique SCSI ID. You must ensure that the SCSI ID of the drive is not the same as the host adapter (typically ID 7) and to ascertain whether or not the FFD shares the SCSI bus with additional drives. After doing this, assign an unused ID to the FFD. If the FFD is the only device on the SCSI bus, the ID should be left at the factory default, 0. To select the required ID, set the DIP switches according to Table 1.

Table 1: SCSI ID DIP Switch Settings

SCSI ID	Switch 3	Switch 2	Switch 1
0 ¹	OFF	OFF	OFF
1	OFF	OFF	ON
2	OFF	ON	OFF
3	OFF	ON	ON
4	ON	OFF	OFF
5	ON	OFF	ON
6	ON	ON	OFF
7	ON	ON	ON

1 Default factory setting

5.2.2 Termination

The SCSI bus must be terminated at the two physical ends of the cable. Only the devices connected at either end supply terminations. Devices that are not located at the end of the cable must have their terminations disabled; otherwise they will cause a degradation of the signal quality. Too many terminations will cause intermittent errors or other problems when accessing devices on the SCSI bus. If the FFD is the last device on the cable, then the terminations must be enabled by setting the DIP switch according to Table 2.

Table 2: Termination DIP Switch Settings

Termination	Switch 4
Enabled ¹	ON
Disabled	OFF

1 Default factory setting

5.2.3 Termination Power (TRMPWR)

Termination power must be supplied by at least one device on the SCSI bus; it is normally supplied by the host adapter. However, if you are unsure whether TRMPWR is available in your system, you can configure the FFD to supply TRMPWR. Note that several devices can supply TRMPWR without affecting overall system performance or causing damage to the drive (or any other device on the bus). If TRMPWR is not available in the system, this will lead to intermittent errors and other problems. TRMPWR is enabled by setting the DIP switches according to Table 3.

Table 3: Termination Power (TRMPWR) DIP Switch Settings

TRMPWR	Switch 5
Enabled	ON
Disabled ¹	OFF

¹ Default factory setting

5.2.4 Write Protection

The FFD has an internal active write protection option. The write protection (WP) is software implemented, and the switch value is retrieved during the FFD power cycle/bus [device] reset. Toggling the WP switch must be followed by a reset to activate the write protection option. Write protection disables the FORMAT, WRITE, WRITE EXTENDED, WRITE BUFFER AND SECURITY ERASE commands, but does not disable the security erase interrupt. It is enabled/disabled by setting the DIP switch as described in Table 4.

If an attempt is made to execute the disabled commands, a command returns in Check Condition status with a WP Sense Key.

The WP switch must be toggled before powering up the FFD.

Table 4: Write Protection DIP Switch Settings

Write Protect	Switch 6
Enabled	ON
Disabled ¹	OFF

¹ Default factory setting

5.3 FFD 3.5" SCSI Flash Disk Drive Installation

The FFD can be installed in any mounting position in the system. Unlike rotating disks that have an axis of rotation, the FFD is not susceptible to damage due to orientation.

Note: It is not necessary to perform a low-level format on the FFD. The drive is shipped low-level formatted and ready for use.

5.3.1 Installing the FFD in a PC

If your SCSI host adapter is not installed in the system, follow the installation instructions supplied with the adapter before proceeding with the FFD installation, detailed below. Most SCSI adapters include a BIOS expansion that allows the system to boot from the FFD after it is properly configured and high-level formatted. In addition, the BIOS expansion automatically installs support for the FFD and assigns it a drive letter for use under DOS or other operating systems.

To install the FFD:

1. Power down the PC and remove the cover.
2. Check the adapter's memory, I/O, and IRQ settings and verify that they do not conflict with any other devices installed in the system.
3. Configure the FFD's DIP switch settings according to the information provided in Section 5.2.
4. Verify that the SCSI bus is properly terminated. Refer to Figure 2 for termination configuration options.
5. Connect a 50-pin ribbon cable between the FFD and the adapter. Make sure to orient the cable so that pin 1 of the FFD is connected to pin 1 of the host adapter. Neither the host adapter nor the FFD must be at the physical end of the cable, unless they are the only two devices connected to the bus. If additional drives are present in the system, make sure that the cable runs from device to device in a continuous manner, without branches.
6. Connect a power cable from the PC's power supply to the FFD.
7. Mount the FFD into a free drive bay.
8. Close the cover and power ON the PC. The host adapter's BIOS sign-on message appears, displaying a list of the installed devices (see Figure 3 for an example of an Adaptec host adapter).

You are now ready to use the FFD. IF you encounter any problems, refer to Section 8 for troubleshooting information.

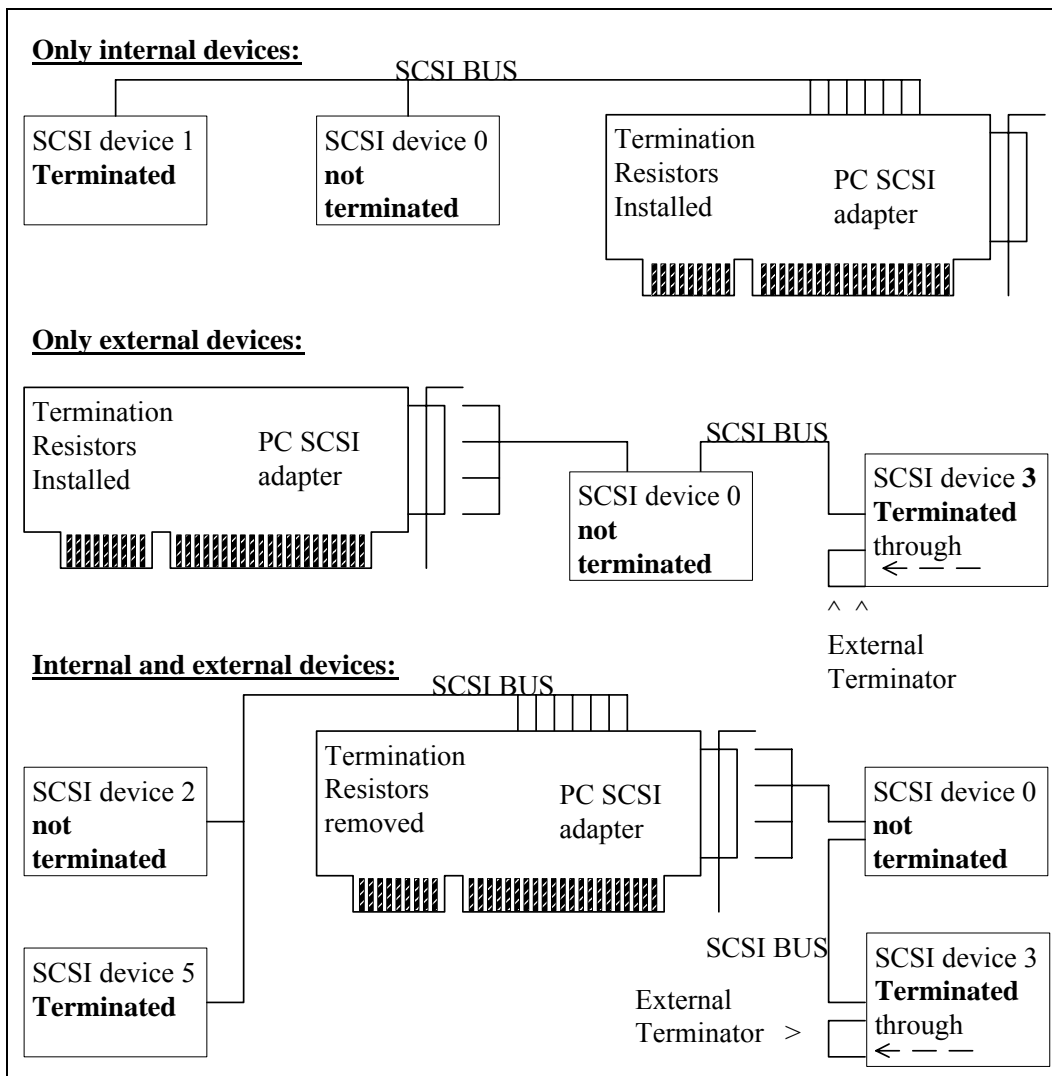


Figure 2: SCSI Cable Connection and Termination Configuration

```

Adaptec AHA-2940 Ultra/Ultra W BIOS v1.23
(c) 1996 Adaptec, Inc. All Rights Reserved
<<< Press <Ctrl> <A> for SCSI Select (TM) Utility >>>

SCSI ID: LUN NUMBER ## 0:0 – M-Systems FFD 350/FMAX 5D – Drive D:
(81h)
    
```

Figure 3: BIOS Sign-On message

5.3.2 Using the FFD on a DOS-Based Platform

After physically installing the FFD, it must be installed as a disk drive under DOS. Run the DOS commands listed below and follow the instructions displayed for each command. For more information regarding the DOS commands, refer to your DOS manual.

To install the FFD as a disk drive under DOS:

1. Run the DOS FDISK program to partition the FFD. If you want the FFD to be a bootable drive, run "Set Active Partition" using the FDISK utility.
2. Run the DOS FORMAT command to high-level format the FFD.
3. If you want the FFD to be a bootable drive, run the DOS SYS command.

Note: Some SCSI host adapters require the installation of a device driver to access SCSI disk drives. In this case, follow the instructions included with your adapter to configure the system and install the FFD as another drive under DOS.

5.3.3 Using the FFD on a UNIX-Based Platform

Most UNIX systems come preconfigured with a SCSI host adapter and a hard disk already installed on the SCSI bus. Follow the instructions below to install the FFD in your system. If a platform does not have room for additional drives, an external unit is required to mount the FFD. External units typically include a 3.5" drive bay, power supply and cables.

WARNING! - Installing any disk drive on a UNIX system is a very complex procedure. If you are not an expert, consult your system administrator for help. Failure to do so can lead to loss of data on existing drives in the system.

Refer to your UNIX documentation for more details regarding the installation procedure for SCSI disks under UNIX.

To install the FFD in a UNIX-based platform:

1. Power down the system.
2. Configure the FFD's DIP switch settings according to the information provided in Section 5.2.
3. Verify that the SCSI bus is properly terminated. Refer to Figure 2 for termination configuration options.
4. Connect a 50-pin ribbon cable between the FFD and the adapter. Make sure to orient the cable so that pin 1 of the FFD is connected to pin 1 of the host adapter. Neither the host adapter nor the FFD must be at the physical end of the cable unless they are the only two devices connected on the bus. If additional drives are present in the system, make sure that the cable runs from device to device in a continuous manner, without branches. Note that some systems require a cable with two different types of connectors, one for the FFD and one to interface with the system's host adapter.
5. Connect a power cable from the system's power supply to the FFD.
6. Mount the FFD into a free drive bay.
7. Close the cover and turn the power ON.

You are now ready to install the drive under UNIX. If you encounter any problems, refer to Section 8 for troubleshooting information.

In order to proceed with the installation, you must have Supervisor privileges on your UNIX system. If you do not have these privileges, contact your system administrator.

To install the FFD as a drive under UNIX:

1. Run the UNIX *format* utility and follow the displayed instructions.
2. Select the FFD from the list of drives.
3. Define a new drive and manually enter the drive parameters using the *type* option. Refer to Table 5 for a list of the appropriate drive parameters.
4. Define the partitions according to your system requirements.
5. Run the *format* and *analyze* command.
6. Use the *label* command to partition and initialize the drive.
7. Exit the *format* routine.
8. Build the file system on the FFD, using the UNIX *makefs* utility.
9. Mount the drive and place the appropriate link commands in your startup script.

6 Drive Parameters

Most SCSI device drivers can automatically detect the total number of sectors on the FFD, using the READ CAPACITY command, and configure them accordingly. However, some older device drivers must obtain the drive geometry parameters manually. The physical drive parameters are only a convention, and have no effect on how data is stored on the FFD.

Table 5: Drive Parameters

Unformatted Disk ¹ Capacity (MB)	Formatted Disk Capacity (# of blocks) ²	Cylinders	Heads	Sector/Cylinder	Bytes/Sector
32	F1FFH	3CH	10H	40H	512
64	1E3FFH	79H	10H	40H	512
128	3CF7FH	F3H	10H	40H	512
192	5BAFFH	16EH	10H	40H	512
256	7A67FH	1E9H	10H	40H	512
320	991FFH	264H	10H	40H	512
384	B7D7FH	2DFH	10H	40H	512
448	D68FFH	35AH	10H	40H	512
512	F547FH	3D5H	10H	40H	512
576	113FFFH	450H	10H	40H	512
640	132B7FH	4CAH	10H	40H	512
704	1516FFH	545H	10H	40H	512
768	17027FH	5COH	10H	40H	512
832	18EDFFH	63BH	10H	40H	512
896	1AD97FH	6B6H	10H	40H	512
960	1CC4FFH	731H	10H	40H	512
1,024	1EB07FH	7ACH	10H	40H	512
1,088	209BFFH	827H	10H	40H	512
1,152	22877FH	8A1H	10H	40H	512
1,216	2472FFH	91CH	10H	40H	512
1,280	265E7FH	997H	10H	40H	512
1,344	2849FFH	A12H	10H	40H	512
1,408	2A357FH	A8DH	10H	40H	512
1,536	2E0C7FH	B83H	10H	40H	512
1,664	31E3FFH	C79H	10H	40H	512
1,792	35BAFFH	D6EH	10H	40H	512
1,920	3991FFH	E64H	10H	40H	512

Unformatted Disk ¹ Capacity (MB)	Formatted Disk Capacity (# of blocks) ²	Cylinders	Heads	Sector/Cylinder	Bytes/Sector
2,048	3D68FFH	F5AH	10H	40H	512
2,176	413FFFH	1050H	10H	40H	512
2,304	4516FFFH	1145H	10H	40H	512
2,432	48EDFFFH	123BH	10H	40H	512
2,560	4CC4FFFH	1331H	10H	40H	512
2,688	509BFFFH	1427H	10H	40H	512
2,816	5472FFFH	151CH	10H	40H	512
3,072	5C20FFFH	1708H	10H	40H	512
3,328	63CF7FH	18F3H	10H	40H	512
3,584	6B7D7FH	1ADFH	10H	40H	512
3,840	732B7FH	1CCAH	10H	40H	512
4,096	7AD97FH	1EB6H	10H	40H	512
4,352	82877FH	20A1H	10H	40H	512
4,608	8A357FH	228DH	10H	40H	512
4,864	91E3FFFH	2479H	10H	40H	512
5,120	9991FFFH	2664H	10H	40H	512
5,376	A13FFFH	2850H	10H	40H	512
5,632	A8EDFFFH	2A3BH	10H	40H	512

Notes:

1. The memory capacity is user specified when replacing the order.
2. The number of logical blocks as reported by the Read Capacity command.

7 LED Indicators and Configuration Switch

Figure 4 illustrates the two LEDs located on the FFD front panel. Table 6 Describes the LED color codes and status definitions.

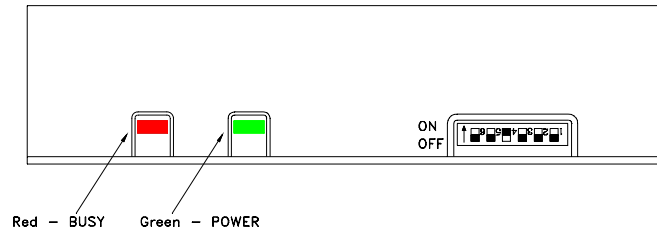


Figure 4: Front Panel LED Indicators

Table 6: LED Status Description

Status	LED Color Indicator	Description
POWER	Green	Indicates that power is applied to the disk. The LED remains ON if everything is okay, and flashes at a rate of 1 Hz to indicate that the power-up and built-in self test have failed and that the disk is malfunctioning.
BUSY	Red	Indicates that the FFD is being accessed. The LED is lit when the disk is accessed (read/write/format) and remains lit until the access is completed.

8 Troubleshooting

8.1 Built-In Self Test

The FFD performs a self-test during power up. If the test fails, the green LED flashes at a rate of 1 Hz. If you encounter this problem, please contact your dealer or technical support.

8.2 Common Problems

The following sections describe common problems and their causes.

8.2.1 Installing Your SCSI Host Adapter

A SCSI host adapter is basically a standard PC board, regardless of the bus system used.

For example:

To install a standard Adaptec 1542CF:

1. Check the default values of the board and verify that they do not conflict with other devices in the PC.
2. Check the I/O-address range, the IRQ(s), DMA channel, and the BIOS address for conflicts. When using a memory manager, exclude the selected BIOS address space from its memory pool. When selecting all resources, enter them in your list of resources.
3. Install the host adapter in the PC and power it ON. If you did not un-install the BIOS, a BIOS boot message similar to the following is displayed:

```
Adaptec AHA-2940 Ultra/Ultra W BIOS v1.23

(c) 1996 Adaptec, Inc. All Rights Reserved

<<< Press <Ctrl> <A> for SCSI Select (TM) Utility >>>

SCSI ID: LUN NUMBER #:# 0:0 – DEC DSP3085S-B SD16 – Drive C: (80h)

SCSI ID: LUN NUMBER #:# 1:0 – M-Systems FFD 350/FMAX 5D – Drive D:
(81h)
```

The boot-up message lists all devices on the SCSI bus that are powered ON. Additionally, it indicates if any of the devices are disks that are supported by the BIOS.

4. Power OFF the PC and install the SCSI device(s). If you have more than one internal device:
 - Set up a unique SCSI ID (not 7) on each of the devices.
 - Select one of these devices to be at the end of the cable.
5. Make sure that the chosen device has its termination enabled and disable termination on all other devices. Termination is either enabled through one or more jumpers, or by installing or removing some resistor packs on the device's PCB.

6. Attach the SCSI cable to the host adapter and to the last device. Do not forget the device's power connector.
7. Power ON the PC and verify that the host adapter recognizes the SCSI device.
8. If the SCSI device is recognized, power OFF the PC and install the next device. Verify recognition for the next device and then install. From this point on, the system should be up and running.
9. If you performed a BIOS uninstall procedure, or if the host adapter has no BIOS, the system will not recognize the devices until the drivers are installed.

8.2.2 Termination Configuration

When configuring termination, the basic rule to remember is termination is required at both ends of the SCSI chain.

- To install a new device as the last device on one of the sides of the complete cable, you must enable termination on the device.
- When replacing another device that was previously at the end of the cable and is now installed on another connector on the bus, you must disable termination on the device.
- When installing an external SCSI device in a system that has only internal devices, you must disable the host adapter's termination using one of the following methods:
 - Using software (as with the newer Adaptec).
 - By removing the terminator packs (typically three) near the host adapter's SCSI connector.
 - By setting a jumper on the host adapter.

The situation is the same if you previously had only external devices.

8.2.3 SCSI ID Configuration

When configuring the SCSI ID, first locate a free SCSI ID. The most effective method is to look at the host adapter boot-up message and check for free IDs.

```
Adaptec AHA-1540CF/1542CF BIOS 2.01s
(c) 1993 Adaptec, Inc. All Rights reserved
Press <Ctrl><A> for SCSISelect(TM) Utility!
Target #0 - DEC DSP3085S-B SD16 - Drive C: (80h)
Target #1 - QUANTUM LP425S 606_ - Drive D: (81h)
Target #3 - TOSHIBA CD-ROM XM-3301T
Target #4 - SDI LASERSTOR E5
```

In this example, ID **2**, **5** and **6** are free for new devices. ID **7** cannot be used, as this is the host adapter. The FFD uses DIP switches to set the ID in a 4-2-1 configuration. The sum of the switch values determines the ID. For example, if you want a hard disk with ID **0**, set all three switches to OFF.

8.2.4 Solving Installation Problems

The problems that arise in most installations are described below.

Unstable Termination

This occurs when there is a passive termination with Fast-SCSI devices on the bus.

Incorrect Termination

This occurs when there are too many devices terminated, or when the SCSI bus cable ends are not terminated.

Cables

Avoid using homemade, short, flat ribbon cables with bad contacts or cheap cables. Do not mix round cables with flat cables.

Cable Length

Ensure that the cable length is within the limit specified in the standard, and avoid using cables that are too long to support the transfer rate.

Device ID Conflict

This occurs when a new device is added with a SCSI ID identical to an existing device on the bus.

Missing TRMPWR

This occurs when the host adapter or at least one of the devices on the SCSI bus does not supply termination power.

Missing Software Device Driver

Some host adapters do not install support for SCSI drives as an expansion BIOS. In this case, load an additional driver for your operating system after the system boots. Note that this configuration cannot boot from the SCSI drive.

9 Getting Help

For technical assistance with the installation and configuration of your FFD, contact one of the sources listed below. Please have the following information available to aid the customer support representative in providing you with the best possible guidance:

- Product and serial number of your FFD.
- Description of your computer hardware (manufacturer, model, attached devices, etc.).
- Description of your SCSI host adapter and associated drivers.
- Description of your software (operating system, version, application software, etc.).
- A complete description of the problem.
- The exact wording of any error messages.

Before contacting M-Systems directly, first contact your dealer. If your dealer cannot provide the help you need, you can obtain technical support from M-Systems directly at one of the numbers listed at the end of this manual.

10 Frequently Asked Questions (FAQs) About SCSI

Q: What is SCSI?

A: SCSI (Small Computer System Interface) is a general-purpose, parallel bus system. It originated with Shugart's 1979 SASI (Shugart Associates System Interface), and Shugart and NCR presented it to the ANSI in 1981. It became official in 1986, when the ANSI-committee X3T9.2 defined the SCSI-1 spec as Document X3.131-1986.

SCSI is now an acknowledged and very well standardized multipurpose interface in all its flavors. SCSI supports a wide variety of devices, including hard disks, removable disks, magneto-optical devices, tape drives, printers, processors, WORMs, CD-ROMs, scanners, medium-changers (jukeboxes), and communications devices.

Q: What is SCSI-1?

A: SCSI-1 defined a universal 8-bit I/O-bus that allows connection of up to 8 devices, including the host adapter. Every device must have a unique ID in the range of 0-7. SCSI-1 was a high-speed bus system compared to the era's existing peripheral devices.

Q: What is SCSI-2?

A: Although SCSI-1 was the first approved standard, it lacked various parameters and definitions. This led to SCSI-2's development and approval before SCSI-1 was even officially approved. In 1986, when SCSI-1 was officially approved, SCSI-2 already was far along in the development process. The official SCSI-2 designation is X3.131-1994.

SCSI-2 provided a better formal definition, removed some oddities and obsolete items, added some extensions, and most importantly, added the ability to double and even quadruple data transfer speed on the SCSI bus with its Fast SCSI and Wide SCSI options.

Q: What is Fast SCSI?

A: Fast SCSI was defined as an option with SCSI-2. Despite the tendency of the market to define Fast-SCSI as "different, but faster SCSI", Fast SCSI is simply an additional synchronous data transfer mode with tighter timing to achieve the 10MB/sec maximum data rate. As with any other synchronous transfer mode, only data transfers are synchronous, while commands are transferred asynchronously.

Q: What is Wide SCSI?

A: Wide SCSI is another SCSI-2 option. There are two defined types, 16 bit and 32 bit. Wide SCSI can be combined with Fast SCSI to provide up to a 40MB/sec data rate.

The X3T9.2 committee defined a 68-pin SCSI cable for the 16-bit type, and a combination of a standard 8-bit 'A' and a 68-pin 'B' cable for 16-bit and 32-bit Wide SCSI. Wide SCSI host adapters can address standard SCSI devices if the correct adapter cable is used.

Q: What is Plug-and-play (P&P) SCSI?

A: Plug-and-play SCSI is an extension of the generic plug-and-play specification. P&P is an approach for defining an auto-configuring environment for ISA boards. One of the key features of P&P-SCSI is SCAM.

Q: What is SCSI Configured AutoMagically (SCAM)?

A: SCAM is a protocol for automatic SCSI ID assignment. It is included in the SCSI-3 parallel interface drafts. The SCAM master (typically the host adapter) scans the bus for attached SCSI devices. For compatibility, it also needs to find and identify legacy (standard) SCSI devices. This scan provides the SCAM master with a map of the attached devices, and it then assigns a valid soft ID to each SCAM-compliant SCSI device. The SCAM master keeps this device table in non-volatile memory to provide an identical ID setup for further boot processes.

Q: What is a SCSI ID?

A: Every SCSI device must have a unique ID on the bus. For this reason, most devices have three ID jumpers to set the SCSI ID from 0-7. With the exceptions of ID 0 and 7, there is no particular ID that must be assigned to a particular device type. Additionally, every ID can have up to seven subunits identified by a LUN (Logical Unit Number), enabling addressing multiple devices through a single ID.

Table 7: General Description of SCSI ID

ID Number	Description
ID 7	Reserved for the host adapter.
ID 0	For a boot device, usually a hard drive.
ID 1	Normally used for a second hard drive, although it is not required.
ID 2 and up	Used for other devices, for example, a CD-ROM.

Q: What is Termination and TRMPWR?

A: The SCSI bus needs to be terminated. This means that both ends of the bus must have a circuit of some sort to eliminate signal reflections that otherwise would occur from the physical ends of the bus. The termination circuit requires power, generally supplied by a line called TRMPWR or Termination Power on the bus. Typically, the TRMPWR source is the host adapter. However, multiple devices can supply TRMPWR without causing damage.

The old, passive termination (Alternative 1 in the SCSI-2 specification) came with SCSI-1 and consisted of a 220 Ω pull-up and a 330 Ω pull-down resistor on each signal.

Active termination (Alternative 2 in the SCSI-2 specification) consists of a 110 Ω resistor on each signal, pulled up to a 2.85V reference supply.

Q: What types of SCSI connectors are available?

A: There are many different connectors for SCSI. Some of them were defined with SCSI-1 and are now obsolete, such as the DB-50 connector. The most common connectors in use today are the 50-pin Centronics-type SCSI-1 connector, the 50-pin High-Density SCSI-2 connector and the DB-25 connector that Apple introduced for Macintosh computers. Most new host adapters and external devices use the SCSI-2 HD.

Q: Cables, Cable Lengths

A: Cable lengths in SCSI-1 and SCSI-2 were defined up to 6 meters maximum, for a single-ended SCSI bus and up to 5MHz data rate.

SCSI-2 allows up to a 10cm cable “stub” length from the device to the main bus cable. Sometimes this length is exceeded, causing higher capacitive loading.

With Fast SCSI-2 the highest possible data rate doubled to 10MHz in synchronous mode and the maximum cable length was halved to 3 meters.

A differential SCSI bus can use the full cable length up to 25 meters (approx. 82 feet) while maintaining a maximum data rate of 10MHz. This is especially important with external devices, as most external single-ended cables prohibit use of 10MHz.

Q: Signal Levels

A: Single-Ended SCSI signal levels vary from 0V to +5.25V. All signals are active low. True is a voltage level between 0 and +0.8 V and false is a voltage between +2 and +5.25 V. Differential SCSI signals conform to the EIA RS-485 interface.

Q: What is Single-Ended and Differential SCSI?

A: There are two different electrical SCSI interfaces, Single-Ended and Differential SCSI. Single-Ended and Differential devices are **not** electrically compatible with each other. Mixing them will destroy the Single-Ended devices on the bus and possibility the differential devices.

- Single-Ended SCSI has single-ended TTL transceivers that allow up to 5MHz data transfer rates with up to 6 meters cable length or up to 10MHz data transfer (Fast SCSI) with up to 3 meters cable length.
- Differential SCSI has RS-485-style transceivers that allow up to 10MHz data transfer rate, but with cable lengths up to 25 meters and with much better S/N conditions.

Q: What are Synchronous and Asynchronous Transfers?

A: SCSI can use two handshaking modes, Asynchronous and Synchronous. The main difference is as follows:

- Asynchronous is basically a “classic” REQ/ACK handshaking system for each data packet
- Synchronous, multiple REQ’s can be issued before receiving ACK’s, thus increasing the overall transfer rate.

How to Contact Us

Internet: <http://www.m-sys.com>

E-mail: info@m-sys.com

USA Office:

M-Systems Inc.
8371 Central Ave, Suite A
Newark CA 94560
Phone: +1-510-494-2090
Fax: +1-510-494-5545

Japan Office:

M-Systems Japan Inc.
Arakyu Bldg., 5F
2-19-2 Nishi-Gotanda Shinagawa-ku
Tokyo +141-0031
Phone: +81-3-5437-5739
Fax: +81-3-5437-5759

Taiwan Office:

Room B, 13 F, No. 133 Sec. 3
Min Sheng East Road
Taipei, Taiwan R.O.C.
Tel: +886-2-8770-6226
Fax: +886-2-8770-6295

Europe & Israel Office:

M-Systems Ltd.
7 Atir Yeda St.
Kfar Saba 44425, Israel
Phone: +972-9-764-5000
Fax: +972-3-548-8666

China Office:

25A International Business
Commercial Bldg.
Nanhu Rd., Lou Hu District
Shenzhen, China 518001
Phone: +86-755-519-4732
Fax: +86-755-519-4729

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e-mail: support@m-sys.com